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THE PLACE OF SCIENCE IN THE ART OF LIGHTING

(Proceedings at a Joint Meeting of the Illuminating Engineering Society and the Royal Institute of British Architects, held at 66, Portland Place, London, W.1, on Tuesday, 18th January, 1944).

Members of the Illuminating Engineering Society were the guests of the Royal Institute of British Architects, in the Institute's building, at 66, Portland-place, London, W.1, on Tuesday, January 18, 1944, when a joint meeting was held to discuss "The Place of Science in the Art of Lighting."

Mr. PERCY THOMAS (President R.I.B.A.) presided and was accompanied by Dr. H. BUCKLEY (President I.E.S.).

The discussion was opened by Mr. Alister MacDonald, F.R.I.B.A. (Chairman Architectural Science Board of the R.I.B.A.), and Mr. R. O. Ackerley, F.I.E.S. (Past-President I.E.S.), who illustrated their remarks by means of lantern slides and demonstrations.

The CHAIRMAN offered a warm welcome to the President and Members of the I.E.S. It was quite obvious, he said, that during the last few years architects had become more and more appreciative of the important part which lighting must play in their designs. In the post-war days, which he hoped would soon be with us, when normal activities could be resumed, "architectural lighting," as distinct from merely "lighting," would play a much greater part in design than had been the case formerly. The trend of events just prior to the war and, in a measure, since the war began, had shown more and more that architectural lighting was going to be increasingly an integral part of our buildings.

It was a privilege, therefore, to welcome the President and members of the I.E.S. He looked forward with pleasure and interest to the discussion, for not only were architects anxious to learn more about architectural lighting but they realised that they must work in close collaboration with lighting engineers.

Dr. H. BUCKLEY (President I.E.S.), thanking the Chairman for his expression of welcome, said that in the past the members of the I.E.S. had had very little opportunity of discussing lighting problems with the architects. Therefore, they appreciated very much indeed the opportunity of attending a joint meeting with the architects in their beautiful home, and of discussing problems of mutual interest. Before the war a section of the I.E.S. had collaborated with the architects; but the present occasion was the first full joint meeting of the two bodies.

Architects and illuminating engineers were separated in some degree by differences in their vocabularies. Illuminating engineers spoke of lumens, foot-candles, iso-candle diagrams, and so on, which terms were, perhaps, not fully understood by others. Again, the architects used certain expressions which, perhaps, did not appear to have any exact quantitative significance. He believed that illuminating engineers were sometimes thought to over-emphasise the technical intricacies of theory and to under-emphasise the more human aspect of their art; indeed, some lighting installations had been described as designed to please the designer father than for the comfort of the user.

Whether or not such criticisms were justified, the joint meeting could not fail to be of interest and value. Bearing in mind the rapid development of light sources during the last few years, it seemed to him that after the war lighting might be regarded less from the purely utilitarian point of view and more as an amenity in our civilisation; in that case there could be no doubt that the architectural and decorative aspects would become more important, and architects would be given far greater scope in lighting than they had enjoyed in the past.

In opening the discussion, Mr. MacDonald and Mr. Ackerley did not de-

liver formal addresses. Instead, they dealt with various aspects of the subject separately, so that from time to time each had the opportunity to comment on the other's remarks and to demonstrate the principles they were discussing.

Mr. ALISTER MACDONALD said the resolving of the discussion "The place of science in the art of lighting" depended on many things and on diverse attitudes of mind; Mr. Ackerley and himself had had many arguments about the subject, both on and off the point. Indeed, he had sometimes wondered whether the more correct title would be "The place of art in the science of lighting." Perhaps that would have been the title had the architects been the guests of the I.E.S.

One line of thought, however, was definitely clear to him. He was hoping that the discussion might help to dissipate, first, the architect's lurking fear that "this thing science" was an enemy carefully to be watched lest he steal a march and gain superiority in certain directions; and secondly, the lighting engineer's feeling that the architect was just one of those unfortunate cogs that one had to put up within the scheme of things.

In the Charter of the R.I.B.A. it was stated that "Thomas Philip Earl de Grey and divers others of our loving subjects have associated together for the purpose of forming an Institution for the general advancement of Civil Architecture, and for promoting and facilitating the acquirement of the knowledge of the various Arts and Sciences connected therewith . . . and have formed a collection of Books and Works of Art and have established a Correspondence with Learned and Scientific Men in Foreign Countries for the purpose of Inquiry and Information upon the subject of the said Art." The original date of that was 1837; it was so long ago that perhaps by now many had forgotten the science part and had remembered only the art part.

Good building, continued Mr. MacDonald, relied finally on good art; but good art in building could not be expressed nowadays without a solid scientific basis of construction, owing to the entirely new levels at which people lived, and which had been created in the past thirty years or so. Recently there had been considerable quickening of the public appreciation of the part that scientists could play in producing a better and more economic life for us all. The building community was as bad a sinner as anybody else before the war in not troubling to understand the vast improvements in building that could be effected in co-operation with science. The R.I.B.A. had always had its Science Standing Committee, and it had extended its contacts recently by setting up an Architectural Science Board, having a personnel drawn, not only from members of the Institute, but also from scientists, including medical men. The terms of reference were:—

> "To promote the use and facilitate the acquirement of Science in the advancement of Architecture."

Architects must set to and understand where science could help them; and Mr. MacDonald emphasised that science wished to be the handmaiden, not the dictator. If they did not open their minds to that growing force they would very soon find—and every thinking person knew it in his heart of hearts—that even the mere expression of their art would be denied them. Curiously enough, it would be the pure scientists who would most insistently desire that the artist or aesthetic mind should interpret science to the people. At one of the Architectural Science Board meetings, when they had been honoured and delighted by the presence in the Chair of Sir Edward Appleton (Secretary of the Department of Scientific and Industrial Research), Sir Edward had emphasised the necessity for the artist; he had said that application of certain scientific discoveries was best figured out by artists because they had a keen appreciation of balance as well as of beauty.

However, said Mr. MacDonald, inasmuch as artificial lighting was under discussion, he must hang his thoughts on that peg, or perhaps switch! There was a saying that one should pay particular attention to the comfort of one's bed and mattress, because one-third of one's life

was spent lying on it. The same might be said about the relationship between building and artificial lighting. It was one of the most important considerations in planning a building and in designing the architectural effects in that building. He was not thinking only of palaces, but also of the simple cottage, if it were lucky enough to be on the "grid." One rather naturally thought in terms of electricity when considering artificial lighting. There were other media, but he believed the great majority would agree on the utility of electricity. Thus, although electricity would be used as the medium for the purposes of the discussion, he emphasised that all the arguments, and the illustrations to be described by Mr. Ackerley, would suit equally well other types of artificial lighting, for they were concerned with the application of light to buildings and not the specification of an electrical installation.

Artificial lighting was one of the main ingredients in the make-up of a good architectural design; in other words, a building could be a good habitable building only if it had good artificial lighting.

To illustrate his point, Mr. MacDonald showed, by means of lantern slides, some examples of good and bad lighting.

First, he showed a picture of a hall so badly lit that its architectural form was not discerned. Beside it was another picture of the same hall properly lit, so that its contents could be seen to full advantage and its architectural features appreciated.

The subject of the second illustration was a Board Room, with a long table in the centre and some very interesting detail, including carved panelling, on the walls. In the first picture the lighting was quite inadequate, so that one could neither work at the table nor appreciate fully the beauty of the architectural features. Side by side with it was a picture showing the room with adequate lighting designed to enhance those features and to enable its occupiers to work in comfort.

In the good old days, he continued, when baronial halls were lit at night by candles and torches, science had little place in the art of lighting. The art had flourished on the impetus of the artist alone. Lighting effects were more simply obtained, but were most effectively obtained by an artist because the materials at hand were simple. Owing to the lack of variety of artificial lighting, man had been content to restrict his activities in the evenings. Glass had come to be used both as a decorative and a reflective agent; and then mirrored glass was used. Newer technique came in, over which the artist could not retain complete control.

At this stage Mr. MacDonald commented that he also could not retain complete control of the newer techniques. Therefore, he invited Mr. Ackerley to demonstrate how modern lighting involved new techniques and how science came into the problem.

Mr. R. O. ACKERLEY said it was quite true that the architects' problem in dealing with lighting nowadays had become quite different from the problem as it had presented itself at the time of Wren, for example. One might ask why lighting had become a subject which architects must study. The answer was the tremendous development in light sources which had been effected during the last fifty years or so. Half a century ago the architect had not available any illuminant which would have enabled him to make a real "splash" with light; there had been no technique of high illumination because there were no sources of high illumination. Rarely had he been troubled with glare, for there were no glaring sources of light. For instance, in those early days 6,000 candles would have been needed to give a standard of lighting such as that provided in the meeting hall; that standard or intensity of lighting was, in fact, provided from 24 points. Naturally, those 24 light sources would introduce glare if they were not properly controlled. That explained simply why modern lighting introduced new problems.

Only during the last twenty-five years had there become available light sources anything like those used to-day. The earliest electric lamps were introduced little more than fifty years ago. The gas-filled lamp had been introduced since the war which ended in 1918. Later there was the

coiled coil filament lamp, then electric discharge lamps, and—the latest development of all—the fluorescent lamp, with its very high light output. In respect of gas lighting sources, similar advances had been made.

It was obvious, therefore, why the modern architect had to consider lighting in a manner quite different from his predecessor. He had no historical precedents to fall back upon.

Accepting that modern lighting was a new subject, why was it scientific? Mr. Ackerley answered the question by giving a few typical examples of the manner in which science entered into the problem of lighting, if one were to make proper use of the light sources and fittings, etc., which modern illuminating engineering had placed at our disposal.

The first thing to be decided was the illumination that was required. One might require a very low intensity of illumination in a room when those present wished to sit around the fire and chat. On the other hand, one might require a high intensity of illumination when performing certain tasks, such as sewing on black material. The point was that for every purpose there must be some appropriate illumination.

Therefore, Mr. Ackerley displayed, by means of a lantern slide, a part of the Lighting Code produced by the Illuminating Engineering Society to indicate the broad outline of the Code, which gave guidance as to the illumination required for various broad categories or classes of work. For example, one of the categories covered by the Code referred to prolonged visual critical tasks. Before one could decide to what this category was applicable, one must first know what constituted a prolonged visual task, and one must have an understanding of the basic factors which influenced the standard of lighting. Matters such as size of detail, contrast, movement, colour, background, and so on, entered into the determination of the correct illumination, and one must have an understanding of their relative influence.

Having determined the standard of illumination required, one had next to decide how it was to be provided in the roon concerned. Tables of coefficients of utilisation had been published to assist builders and designers in the provision of proper lighting, but it was necessary to appreciate what they meant. There were all sorts of factors affecting the amount of lighting produced in a particular room. To start with, one had to consider the size of the light source and the amount of light it gave. Next was the efficiency of the fittings used, i.e., how much of the light given by the lamps was allowed to get out of the fittings. Then one had to consider some of the less obvious factors, as, for instance, the size and shape of the room to be illuminated; that did not mean the floor area, but the relation of the walls, the ceiling, and the floor one to the other. Then one had to consider the decorations and the different results achieved according to the manner in which the light was distributed.

Using a model of a room, Mr. Ackerley demonstrated the results obtained with two different sorts of fittings and two different decorations; the lighting intensities in each set of conditions were indicated by an illumination meter, the dial of which was projected on to the lantern screen, the pointer moving along the scale to show the light intensity in foot-candles.

Using a very light colour of decoration in the room and a direct lighting fitting, the lighting intensity, as shown by the meter, was 28 ft.c. With a darker decoration, equivalent to oak panelling or a rather darkish paper, the intensity of lighting was 24 ft.c. Though the reduction of intensity was not remarkable, it was noticeable.

Using indirect instead of direct lighting with the dark decoration, the intensity was 14 ft.c.; and. with the light-coloured decoration and indirect lighting, the intensity was 30 ft.c.

Thus, whilst the decorations in a room made a difference with any system of lighting, they made a very much greater difference when using one system of lighting than when using another. The reason why could be explained only by one who had a certain amount of scientific understanding of the problem.

The next factor was that of distribution, to ensure that the lighting was

not uneven, and that shapes, figures, and architectural features were correctly revealed. Illustrating it diagrammatically, Mr. Ackerley showed a circular pillar, in plan, lit from one direction. There were three different angles of distribution from the light source, the same amount of light coming along each of them. The light coming directly from the source to the centre of the pillar, as seen from the source, spread over a distance of only 11 mm. of the circumference of the pillar, but the light coming from the source to the sides of the pillar was spread over twice that distance. Obviously, therefore, there would be a gradual falling off of the lighting intensity from the centre to the sides of the pillar, as seen from the source; and it was because we were familiar with the degree of falling off that we were able to recognise the various shapes. If one used a lighting system which took no account of this factor, the shapes might be distorted or disappear entirely.

In a further demonstration of light distribution, Mr. Ackerley used a plaster panel with a figured surface and directed light on to it. Light which was directed from one side only distorted the relief by heavy shadows, so that practically all the features were lost. With light from another angle the effect was flat and little feature could be seen. When light was directed from both sides, the features began to show up. When light was added from the top, the features could be seen still better, though they were still a little flat; but with the addition of more side lighting, the relief was shown up perfectly.

Continuing, Mr. Ackerley reminded his audience that there were three factors in seeing: the eye, the light, and the objects to be illuminated; and the tremendous influence of the object to be illuminated was not always appreciated. By arranging the light according to the type of object to be illuminated, taking advantage of the qualities of that object and dimming out the blemishes, quite different effects could be obtained, if one understood the reaction which the object would have to light.

For demonstration, Mr. Ackerley displayed a piece of velvet, on various parts of which the nap had been brushed in different directions, and showed that by lighting from different directions one could give it different appearances. In the ordinary lighting of the meeting hall, there was a difference of colour as between the sections of material where the nap was brushed in one direction and those where the nap was brushed in the opposite direction; the material had a chequer-board appearance. A bright light in a reflector was directed on to the material from different angles. When that light was directed from certain angles the chequer-board pattern disappeared, but when the bright light was directed on to the material from the front, the patches stood out in greater contrast. Directional lighting could have a very much greater effect on some objects, according to their nature.

Illustrating the application of that idea by an architect, he showed a photograph of a frieze (in a theatre) dark at the top and light at the bottom. The material of the whole frieze was the same, the only difference being the direction of the nap.

Another photograph illustrated the fact that light coloured objects gave rise to specular reflection, and thus tended to obscure the background. It was important to appreciate, said Mr. Ackerley, the characteristics of the objects to be illuminated and the effects to be obtained from them.

The degree to which light could be controlled depended to a great extent upon the amount of space which could be made available for that purpose. Sometimes it had been suggested that the amount of space which engineers had demanded for the purpose of controlling their lighting was ridiculous, and some people had accused them of thinking that architects designed buildings in order to house the fittings which engineers designed. If the amount of space requested by the engineer were so large that it would spoil the design, obviously the engineer must give way; but he should explain what effect it would have on the lighting if he were not allowed the space that he wanted. There was a definite relation between the space which could be allowed the engineer and the

degree of control which he could exercise. Mr. Ackerley illustrated the point diagrammatically, showing how, by the enlargement of a cornice, behind which the lamps were housed, one secured more control and a greater amount of light.

There were also some physiological problems of light which it was necessary to understand. In that connection he exhibited two frames, in which there were some polished ball bearings, symmetrically arranged. The only difference between them was in respect of the size of the balls. In the frame containing the larger balls there were very considerable highlights or bright portions, whereas the frame containing the smaller balls looked like a grey picture, there being apparently no pattern at all. In the latter case the angle subtended at the eye by each ball was so small that the eye could not resolve detail. The importance of knowing what the eye could and could not resolve was another illustration of the manner in which science entered into the lighting problem.

Again, there was a definite relationship between the distances at which lamps could be placed behind glass and the degree of uniformity of lighting on the glass surface. That relationship varied with each different type of glass.

Demonstrating with four different types of glass, Mr. Ackerley first showed a sheet of ordinary diffusing opal glass with four lamps behind it. The lamps were an equal distance apart, set in a line parallel with the glass, 4½ inches behind it, and the illumination on the surface of the glass was reasonably uniform. When the lamps were brought forward to a distance of 3 inches from the glass they produced a spotted effect, the position of each lamp being clearly visible. By inserting three more lamps between the original four, however, so reducing the spacing between the lamps, the illumination on the surface of the glass was again reasonably uniform, though the distance between the lamps and the glass was 3 inches. This illustrated that uniformity of illumination was a function of space-offset ratio, and could be influenced either by increasing the offset or by reducing the spacing of lamps. That appropriate spacing offset ratio varied with the type of glass was illustrated when a sand-blasted glass was substituted for the opal. With this glass even at an offset of 13½ inches, the illumination with four lamps remained spotty, but when the three extra lamps were switched on the effect became reasonably uniform.

With four lamps at the shorter distance behind figured glass there appeared to be four circular patterns on the surface of the glass, one directly in front of each lamp. As the lamps were moved back to a greater distance behind the glass, the circles overlapped, so that there were highlights, not immediately in front of the lamps, but between them. When the number of lamps was increased to seven the highlights again altered their positions, and there was more overlapping and a nearer approach to uniformity.

Finally, Mr. Ackerley used a piece of glass which was ribbed vertically. With four lamps behind it, the glass surface showed four short horizontal bands of light, end to end, along the centre. When the number of lamps was inereased to seven and the distance of the lamps behind the glass was increased, there was one continuous horizontal band of light along the surface of the glass.

Next, he demonstrated the properties of different types of glass by directing a beam of light on to them. In the first place he showed that clear glass made little difference to the amount or diffusion of light directed through it to an object beyond: it absorbed and reflected little. Opal glass, however, in addition to spreading the beam beyond the glass reflected a certain amount of the light back. Another type of opal glass allowed very little light to pass through, but reflected a lot of the light back. He demonstrated by means of a diagram the manner in which the loss of this reflected light might be saved by reflecting and redistributing it.

Demonstrating the point further, he showed light directed through an opal glass panel, giving an illumination below it of 9½ ft. c. By using

a reflector to catch and reflect the light which would otherwise be wasted by back reflection from the opal, the illumination was increased by nearly 30 per cent. to 12½ ft. c. Even with clean glass there was still an improvement, but not so great as with opal glass.

Thus, it was important to appreciate the nature of the glass used and its effect upon the light which was directed to it.

He was quite prepared to agree that the lighting engineer must be the servant of the architect. Obviously, in some cases the attainment of the desired result from the lighting engineer's point of view would necessitate the use of equipment so big and unsightly as to condemn the whole scheme from the artist's point of view. But if the artist understood the background of the lighting engineer's problem they would be able to effect the necessary compromise.

He submitted that the demonstrations showed that science was a tool which the architect could use to produce lighting results very much better than had sometimes been produced in the past.

Mr. ALISTER MACDONALD said that Mr. Ackerley had demonstrated ably what was meant by the phrase "science of lighting," and it was quite obvious that with that knowledge one could create fully, extensively, and to one's heart's content. Equally important, one could create at economic cost gems of lighting even in a labourer's cottage—and it would be agreed that science knew no distinction of class. All that had been shown by Mr. Ackerley required moulding into the human scale, into forms that pleased as well as registered efficiency. Before a hundred engineers, the guests of the R.I.B.A., he still dared to say point blank that most of the lighting schemes prepared purely on scientific lines would be failures in buildings of any creative quality. Not only did he envisage public buildings, concert halls, houses, and such like so-called architectural buildings; he included the factory and the workshop. "Music while you work" had increased output because it appealed to the emotions of the workers. The artistic control of lights did the same. People were not always inspired by efficiency alone.

Could the engineer understand that there were occasions when soft lights and possible distortion helped human beings to see things better? The business of interpreting human weaknesses and strength was the job of the architect; he designed spaces within which such things existed. The engineer must understand that during that process the architect did not wish to smother the engineer's work. He was providing a setting in which to show the engineer's work to the greatest advantage and to the credit of both the engineer and the architect; and yet the engineer's work had to be lost in order to show it to its greatest advantage.

Mr. MacDonald showed by means of lantern slides a number of examples of lighting.

First he showed a photograph of the interior of a building in which there was a column carrying a great weight. It was doing a really heavy job of work; yet the lighting on it was so graded that it appeared to make that job of work interesting. By way of contrast he showed an interior with an extraordinarily heavy feature which was doing no important work, except that it contained inside it certain electric light bulbs.

The next interior was that of a church. All the lighting was at the top, so that the beauty of the architecture below was lost. Presumably it had been hoped that a good deal of the light would have been thrown downwards from the top; but in fact there was hardly sufficient light below to enable the worshippers to read their hymn books. The other extreme was illustrated by a photograph of the same church after the lighting had been re-designed, presumably by a lighting engineer; he suggested that it was too well lit. Gothic architecture soared towards the heavens; but that particular church was so well lit that it gave

one no opportunity to imagine Heaven.

Classic architecture, on the other hand, would stand up to detail lighting. He showed a photograph of the interior of a church in the Classic style which was well lit, with the shadows in the right places.

A further example of church lighting was shown to give force to his criticism of the installation, which illuminated one side of an arch whilst the other side of it was in shadow.

Other photographs of interiors of various types of buildings illustrated the ill effects of applying light without appreciating either the architect's or the engineer's objects, and the good effects of installations which gave full effect to the architectural features and to the form and line of the building.

In a criticism of "port hole" lighting through apertures spaced symmetrically over the ceiling, Mr. MacDonald said it was very expensive, and he regarded it as irritating in the example he showed. Another installation which he described as irritating was one which accentuated the shadows on the walls.

Some photographs of floodlit exteriors were shown, two of which served to emphasise the criticism that the floodlighting made the buildings appear upside-down, i.e., inasmuch as the lighting was directed upwards from below, the shadows were created above the overhanging pieces, whereas in daylight the shadows were below the overhanging pieces. Thus, floodlighting had produced effects exactly opposite to those which the architect had intended. Another photograph showed a building with recesses at a considerable height, and overhanging pieces above the recesses. The floodlighting produced pockets of shadow above the recesses, whereas during the day there were pockets of shadow at the head of the recesses, so that the whole line which pulled the building together would stand out in contrast to the dark patches immediately below it.

By way of contrast, a photograph was shown of the Arc de Triomphe, on which extra artificial lighting was introduced at the top to throw shadows downwards, thus producing by artificial light the same shadows as were intended by the designer.

Finally, an excellent example of the lighting of relief was shown; it was obvious that the sculptor and the illuminating engineer had co-operated to produce the right degrees of shadow.

Commenting on Mr. Ackerley's reference to compromise, Mr. MacDonald urged that there need be no compromise in the process of joining effectively the work of the engineer and the architect. It had been said that the best things in life were the result of compromise. How horrible! Yet he supposed it was true just sometimes. How long did compromised goods remain the best?

In the matter of artificial lighting, he suggested, there was no real compromise; there was correct balance to achieve the finest results. In order to maintain equilibrium, to every action there must be equal and opposite reaction. So the solid lighting requirements of a room must not overrun the comfort, the maintenance costs, the human effectiveness of the scheme. Similarly, the lighting specification and design of the electrical engineer must not be so cut or muffled by the architect that the lack of complete lighting effectiveness was always present—in other words, the reaction was stronger than the impelling force. The lighting engineer might say that his requirements were the perfect solution and that any alteration represented a compromise. The architect might say that the complete artistic design was spoiled by some extra depth of lighting, shield moulding or too even a surface.

Mr. MacDonald's reply to the engineer would be that if his scientific requirements created a jarring effect they were not perfect in their relation to the room. In other words, they were lighting the room, not just its cubic space and its walls, floors and ceilings. To the architect he would say that, however artistic the appearance of the room, that effect was short-lived if it caused discomfort to the occupier by bad lighting. The architect, if he were worth his salt, would find out that the less he cut down the engineer's requirements,

the more easily would he be able to complete a room which gave complete artistic satisfaction unmarred by maintenance costs.

"Compromise" suggested to him that certain important things might have been axed. A well-considered prescription of ingredients from the illuminating engineer and the artist, finally dispensed by the architect, was the best medicine to ensure good health, physical and mental, when the room was artificially lit.

The sooner the architect and the illuminating engineer learned each other's point of view and training in order to co-operate intelligently and to talk the same language, the better.

To illustrate his point, Mr. MacDonald asked Mr. Ackerley how he thought an architect who knew nothing of the science of lighting might go about the job of lighting a cove.

MR. ACKERLEY replied that in his experience such an architect might work out the design of the whole room before he considered the lighting of it and, perhaps quite rightly, if the room were not large, he would wish to keep the cornice very small. At the last minute he would remember that he could not light the room without lamps, and would get hold of a catalogue or ring up a pal and learn that the diameter of a 40-watt lamp was about 2½ ins.; then he would decide that a cornice 4 ins. wide would be sufficient. Perhaps he would ring up an electrical contractor who, after all, was no more necessarily a lighting engineer than a builder was necessarily an architect, and who would agree that a width of 4 ins. was plenty. Mr. Ackerley showed the result of so doing by arranging a vertical frieze and a 4-in. cornice and placing the lamps behind the cornice. The result was excessively brilliant light just above, the lamps fading off to darkness.

MR. MACDONALD then countered with his conception of how a lighting engineer who had no sense of aesthetic requirements would go about the same job. Taking out a slide-rule, he found that for uniformity of illumination, which he suggested was the engineer's idea of perfection, an offset of at least 24-in. was required. When this was demonstrated it was obvious that the architectural proportions were all wrong.

Mr. MacDonald and Mr. Ackerley then getting together demonstrated with a 7-in. cornice and a curved frieze, to show that good illumination could be obtained without sacrificing architectural proportions.

That, said MR. ACKERLEY, represented a compromise between the engineer and the architect—though Mr. MacDonald did not like the term "compromise," preferring to use the expression "correct balance."

If engineers and architects appreciated each other's point of view, he continued, they would get a little further. The fundamental point was that the background of their training was different. The engineer was objective. He started with a light source, and he learned what happened if it were controlled, and what happened if it were not controlled. If it were uncontrolled it would produce patchy lighting, excessive contrasts, distortion, and waste. He learned how to avoid those things, how to avoid glare, how to ensure the right shapes and colours, how to be efficient. The result was that by the time he had completed his training he thought of those things as desirable in themselves, and he held that nothing was perfect unless efficient.

The point of view of the architect was exactly opposite. He was subjective and was interested in the appearance of things. He might wish to distort shapes deliberately; he might wish to produce some special dramatic effect.

If the engineer appreciated that the architect necessarily regarded his problems from the subjective point of view, which was quite different from his own, and if he appreciated that the things he learnt to do were not necessarily desirable in themselves but that they did facilitate the right compromise, then he and the architect would be able to work together, to the advantage of the whole community.

MR. MACDONALD, summing up, said that obviously there was a place for science in lighting, and architects

must learn to appreciate the training of the lighting engineers. Scientific research had created modern artificial lighting. Was there an art of lighting left, or must we now label the instrument "the science of lighting"? It had been demonstrated that art still had a place in lighting. Both Mr. Ackerley and himself acknowledged that science was the handmaiden, not the dictator. Science was concerned with the research into (which meant the searching after) and tabulation of facts. No sane person would claim that human vitality could ignore it or could afford not to be guided by it; but if science came outside itself and started to organise policy and design, the purity of its fundamental research and, therefore, its own worth would disappear. Briefly, the art of doing something surely meant just the aesthetic and balanced assembly and display of a certain range of matter. Science, through the illuminating engineer, put the tools of artificial lighting into the hands of the architects, and it was up to art to finish the job.

Even in the old-fashioned problem of artificial lighting by candles, observation and bitter experience—a less frightening term than scientific research—had taught the artist not to place the candle too far away from, or too close to, the object to be lit or to inflammable materials. The science of optics had *unconsciously* provided the tools to the artist, in the glass candelabra, etc. Nowadays the scientist, through the medium of the lighting engineer, very *consciously* provided the artificial lighting data for dwellings. The architect practised the art of lighting, and he turned to science to provide him with the most important ingredient in all his recipes. Science provided data which was common to all artificial lighting; the lighting engineer picked out the particular requirements in terms of lighting for a particular building; the architect then put that into the particular architectural form required to complete the design and, therefore, the functioning of the building.

Thus, Mr. MacDonald asked engineers not to think of architects simply as superficial artists, however much the architects might give that impression. Their function was to co-ordinate the work of engineers and of other specialists into a human design for beautiful building. To the architects he would say that beauty was fully expressive only if it gave play to the scientific requirements of lighting engineers and others. Therefore, let them give up the pracice of completing eighth scale drawings before asking in the lighting engineer. The training of the lighting engineer was not of the class that was bent and fitted into architectural design; it was fundamentally required as part of the make-up of the first designs. When the architects had first put down the shape and general disposition of the building and its rooms, let them call in the heating and ventilating and lighting engineers, who might give them ideas as to how their particular scientific subjects could contribute to the improvement or expression of the architects' theme.

The place of science in the art of lighting was as the leader in a team of horses harnessed to a coach driven by the architect coachman to a successful journey's end.

In the course of subsequent discussion MR. HERBERT C. PRIDE said he was sure that the members of the Illuminating Engineering Society were very glad of the opportunity to meet the architects and to discuss with them the necessity for more scientific work in the development of lighting; and that he had enjoyed the manner in which both Mr. Alister MacDonald and Mr. Ackerley had illustrated, with slides and practical demonstrations, their points, which proved the urgency for a closer co-operation between the architect and the illuminating engineer.

He was rather surprised that nothing had been said about the fluorescent lamp, for he felt that it would be a very important source of light for use by architects in the future; at the moment it was being used in the industrial and commercial world with much success. It presents many problems from the aesthetic point of view; and the architect, the illuminating engineer, and the manufacturer, have to collaborate to develop its use in a scientific manner.

Mr. P. J. WALDRAM pointed out that it was not emphasised in the title of the discussion that the meeting was concerned solely with artificial lighting and completely ignored natural lighting or fenestration, which was of no small concern to architects. He suggested that the Science Board might with advantage consider another meeting to be devoted to the discussion of natural lighting; because the behaviour of the eye in daylight gave the clue to many of the mysteries to which reference had been made by both speakers. The lighting engineer dealt with the physical and physiological aspects of lighting, whereas the architect, when dealing with the artistic side, was really solving psychological problems. The eyewas a most capricious organ which had very curious psychological reactions, and those were best dealt with by the architect.

Dr. J. W. T. WALSH endorsed most heartily the title adopted by Mr. MacDonald and Mr. Ackerley, and said that all who had listened to their very original and delightful duet would agree that there was a place for science in the art of illumination. No doubt it would be agreed that every creative work must be the result of a synthesis of one's personal experience enriched by the experience of others as far as possible. The accumulated experience of the illuminating engineer ought to be synthesised with the experience of the architect when engaged in creating a beautiful building. The problem, then, was how best the architect could get hold of the experience of the illuminating engineer and merge it with his own. There was a gap there which it should not be impossible to fill.

Putting forward two suggestions, for which he did not claim originality, Dr. Walsh said the first had been mentioned to him by a member of the R.I.B.A., Mr. W. Allen, of the Building Research Station. It was that a book on lighting should be written especially for architectural students. It should, if possible, be written by two people in collaboration, one an architect having an appreciation of the importance or the place of science in the art of illumination, and the other an illuminating engineer who had learned to appreciate the point of view of the architect.

His second suggestion arose from the fact that, as illuminating engineers knew to their cost, the science of lighting was making rapid progress. It was necessary that all that progress should be made available for use as quickly and as amply as possible. Therefore, he suggested that some means should be found by the R.I.B.A. (either by co-opting someone engaged in the science of lighting to one of its committees or in some other way) to ensure that there was no lag between the advances made by the engineers and the adoption of those advances by the people who were able to apply them for the benefit of mankind.

The meeting, he concluded, had been an intellectual treat, and he hoped it would result in an even greater appreciation of the fact that much was to be gained by a "get together" of that kind.

Mr. L. G. APPLEBEE was rather disappointed that no reference had been made to the lighting of public buildings used for special purposes, for that was a matter calling for the co-operation of the architect and the illuminating engineer. He was not thinking particularly of a building for theatricals, for lighting should not be theatrical, but of buildings generally at which there were public performances, where people sat and looked at something for a considerable time. He had in mind the lecture hall of a university or college, where students had to listen to learned professors, or at a political meeting. Those who were on the platform should be "presented," and in this country there were one or two very good examples of how that should be done.

In that connection he recalled that Mr. Hope Bagnall had been called to the Albert Hall to advise on the elimination of echo. He had designed a very simple and very good setting and had eliminated the echo. Then the problem of the lighting for the musicians had arisen—musicians are particularly fussy over the lighting of the music—and Mr. Hope Bagnall and the illuminating engineer who had designed the lighting attended the first trial under the new condition, and he and the architect had waited, with

their hearts in their mouths, to hear what the musicians would say about the lighting. During a break in the rehearsal they had gone to the platform. Dr. Malcolm Sargent, without knowing that the architect and the illuminating engineer were present, remarked, "I do like this lighting; I feel that we are being 'presented.'"

Similarly, in a hall where a meeting was being addressed by a political speaker, or where there was a table tennis tournament or a boxing ring, light should be used scientifically, so that the speakers or performers should really be outstanding. The lighting of all the items in the setting should be considered very carefully.

As an example, of the scientific use of natural lighting, Mr. Applebee mentioned Napoleon's tomb, in Paris, and said that at a certain time of the day the effect of the natural lighting on it was really extraordinary.

Referring to the lighting of the dress circle of a particular theatre, he recalled that the architect concerned, who was of foreign extraction, had asked for cornice lighting playing on to a domed roof; he had been careful to mention that there was not very much room, and that he had wanted to avoid spottiness. But he had ordered the use of a flat enamel which, when the lights were on, had had the appearance of polished marble; the result was that the eye could pick out each lamp. The illuminating engineer, in despair, had complained that the builders had applied a terrible polish to the illumated surfaces; but the architect had replied that it was delightful and was just what he had wanted. Yet many people had criticised this particular job as a bad example.

Finally, Mr. Applebee, said that the lighting in the meeting hall of the R.I.B.A. was a good example of the type of lighting he was advocating. The hall had a very nice greyish finish, and the lighting was arranged so that it really did "present" the speakers on the platform without being too theatrical; whilst during the lecture the walls and architecture did not predominate.

In most of the halls in which the members of the I.E.S. held their meetings the speakers were not "presented" in that way.

Mr. P. V. BURNETT, who said he had the privilege of being a member of the R.I.B.A. and of the I.E.S., commented on the suggestion that a book should be published explaining lighting to architects, and urged that it was necessary to publish a second book to explain architecture to illuminating engineers. The subject of architecture, the form of buildings, should be included in the studies of students of illuminating engineering; and the study of the moulding of light, which should be considered in the same way as the moulding of physical things, such as concrete, should be included to some extent in the curriculum of the architectural college. Unfortunately, that had not been done so far. Architects had always been a little conservative in their educational system; but the advances in the science and art of lighting had been very rapid, and he had no doubt that the changes he had advocated would come about in due course.

The holding of a joint meeting was a new departure in the R.I.B.A., but the success of the joint meeting with the I.E.S. was such that he hoped it would form a useful precedent for similar meetings in the future, in which the Institute could co-operate with other organisations.

Mr. J. S. Dow remarked that one circumstance which had moulded the methods of illuminating engineers to a great extent had been the scarcity of light in the early days. Inevitably they had become engrossed in the consideration of foot-candles, polar curves, reflectors, and so forth, for they had had no alternative but to concentrate on directing such light as was available into the places where it was needed most. Nowadays, however, light could be considered in a more generous way.

It was true that illuminating engineers were still preoccupied with foot-candles; indeed, they had been accused of suffering from "foot and candle disease." But the expression of illumination values in terms of foot-candles had a real justification, and the values in the I.E.S. Code a scientific background, based on consideration of the size of the object, contrasts, the reflecting power of the

object illuminated, etc. The Society was, however, preoccupied with something further than foot-candle values; in particular, the relation between the brightness of objects and that of their background had a vital bearing on easy seeing and pleasing effect.

It did not seem impossible to frame some guiding rules which could be followed by both the lighting expert and the architect in everyday life. In the United States Mr. Ainsworth had devised a scheme based on "brightness equilibrium"—a term which perhaps needed more elucidation and might serve to indicate the condition which those aiming at "easy seeing" desired.

In connection with the lighting of buildings of great distinction there were doubtless conditions of which the architect was acutely conscious, but which the ordinary lighting engineer did not observe and to which he was not sensitive. In such cases the ultimate decision must rest with the architect, and the lighting expert must endeavour to give the architect what he needed.

He recalled that, in an address which Mr. Percy Thomas had prepared for the Cardiff Centre of the I.E.S.—another service for which the Society was indebted to him—reference had been made to floodlighting. Mr. Thomas had explained that around certain buildings in Cardiff there were large areas of grass, so that opportunity was afforded to place lights so that they would give a natural and pleasing effect. The surroundings of the average building, however, were not such as to afford those facilities: almost inevitably the lights had to be sited near the buildings, so that distorted shadows were difficult to avoid. Did that mean that the floodlighting of such buildings must be discontinued; or should it be possible, in buildings of the future, to make some provision, in the design of the frontage, which would ensure that floodlighting from above, or very near to the surfaces illuminated would not offend too greatly?

The CHAIRMAN extended the hearty thanks of the meeting to Mr. Ackerley and Mr. MacDonald for the trouble they had taken to prepare their addresses and their experiments. Certainly he could say on behalf of the architects, and he hoped he could say also on behalf of the engineers, that the meeting had been not only interesting but extremely useful. By demonstrations such as had been presented at the meeting one could learn twice as easily as by the spoken word.

The vote of thanks was carried with acclamation.

Mr. ACKERLEY, in a brief response, said that the members of the I.E.S. appreciated very highly the opportunity of attending the joint meeting, and they hoped sincerely that they would have an opportunity to entertain the members of the R.I.B.A. in the future. He also expressed thanks to those who had assisted in the demonstrations and in the presentation of the lantern slides.

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

With a view to avoiding possible confusion with other publications, reference to these Transactions should be in the form :—" Trans. Illum. Eng. Soc. (London)."

Sessional Meeting in London

A Sessional Meeting was held at the Royal Society of Arts (John Adam-street, Adelphi, London, W.C.) on March 14, 1944, when the chair was taken by the President (Dr. H. Buckley).

After the Minutes of the last meeting had been taken as read, the Hon. Secretary had made the announcements in regard to forthcoming meetings, the President called upon Mr. J. B. Carne to read his paper on "The Lighting of the Homes of To-morrow."

The paper dealt primarily with lighting conditions in homes in which economy dominates the provision of necessities and amenities. After quoting from social surveys bearing on this question, the author illustrated, by the aid of lantern slides, the most efficient methods of dealing with homes of this character.

In the ensuing discussion, Mr. R. O. Ackerley, Mr. R. W. Ames, Mr. A. H. Owen, Mr. E. G. Guyatt, Mr. J. S. Dow, Mr. E. Stroud, and Mr. G. A. Wedge took part.

After Mr. J. B. Carne had briefly replied, a vote of thanks to the author terminated the meeting.

Forthcoming Sessional Meetings

1944

April 18th. Demonstrations illustrating **Principles of Illumination and Photometry.** *(Joint Meeting with the Science Masters' Association, to be held in the large Physics Theatre at the Imperial College of Science and Technology, South Kensington, London, S.W.7.)* **5 p.m.**

May 9th. Annual General Meeting. Address by SIR CHARLES DARWIN (Director of the National Physical Laboratory) on **Tolerances and their Effect on Physical Measurements.** *(The Meeting will be held in the Lecture Theatre, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.)* **5 p.m.**

Papers Read Before Centres and Groups

ELECTRIC LIGHTING: A CONTRACTOR'S STANDPOINT, by J. ASHMORE, M.I.E.E. *(Member).*

Summary of a paper read before the Birmingham Centre on January 28, 1944.

Mr. Ashmore commenced his lecture by giving a review of the Control of Light from the earliest days to the present time, and followed up with the Progress of Lamp Design in regard to efficiency. Technical aspects and essential requirements necessary for a contractor to plan an efficient lighting scheme, together with correct choice of lighting units, were then discussed. A particular point stressed by the speaker was the importance of introducing legislation for the correct lighting of public buildings, etc., on a similar basis to that adopted for the Factory Act lighting.

Mr. Ashmore emphasised the importance of maintenance of a lighting scheme, a matter that has in the past been much neglected. He then dealt with the future prospects that confronted the contractor, advances in types of light sources, colour and design, and the consideration of interior decoration, and luminous ceilings.

In conclusion, Mr. Ashmore advanced the opinion that it was essential that students should be encouraged to adopt as their careers the profession of Illuminating Engineering and so ensure that the advance that science is now giving to us will be in safe keeping for the future.

After an interesting discussion, the chairman mentioned that Mr. Ashmore had very kindly presented two bound copies of his paper to the Library of the Society, and that these would be available to members for reference in due course.

STREET LIGHTING: CONSIDERATIONS FOR THE FUTURE, by EDWARD C. LENNOX, M.I.E.E. (*Member*).

Summary of a paper read at a joint meeting of the Newcastle Centre and the Association of Public Lighting Engineers on February 2, 1944.

At this meeting there was an attendance of approximately 150, including representatives from many local authorities in the vicinity, a number of whom joined in the discussion.

In introducing his subject Mr. Lennox referred to the great increase in road accidents during the black-out, and urged the necessity for post-war planning of street lighting to meet forthcoming traffic conditions. Mr. Lennox recalled the Report of the Ministry of Transport, issued in 1937, and the difficulties experienced in framing a street lighting specification, and he illustrated, by the aid of lantern slides, the great progress in design of public lighting during pre-war years. It appeared that the immediate future offered no possibilities of revolutionary methods, but rather steady advances on existing lines. He drew attention, however, to certain future developments, such as the increased use of automatic control, further applications of discharge lamps, and the control of expenditure—pointing out the need for more generous allocations than in the past and the vital necessity of having available advice from a competent public lighting engineer who could prepare adequate schemes of lighting and attend to renewals and proper maintenance. He suggested that street lighting should no longer be an optional matter resting only with local authorities, but should be handled by the same Ministry that dealt with streets and roadways. In the case of traffic routes, the Ministry of Transport should be the controlling and supervising body, contributing where necessary to the cost of public lighting, but leaving the administering of details in the hands of local authorities.

HOME LIGHTING AND DECORATION, by ALAN H. OWEN (*Member*).

Summary of paper read before the Manchester Centre on February 10, 1944.

In introducing his subject Mr. Owen recalled the paper on "Modern Domestic Lighting" read before the Society in 1931 by Mr. H. T. Young, who traced the development of the past twenty-five years and illustrated many modern methods of design. His table of recommended values of illumination did not, however, go beyond 5 ft.c.

In the intervening thirteen years much has happened. The lecturer emphasised the better seeing obtained with out-of-door natural lighting even up to 1,000 ft.c., and suggested methods of lighting with fluorescent tubes, by which 120 ft.c. could be readily obtained. He emphasised the importance of avoiding monotony and of securing contrasts in brightness, and the great future possibilities of coloured lighting in the home. He anticipated that after the war fluorescent lamps in new forms and in a great variety of colours would be available.

The use of colour, however, and, indeed, lighting generally, could not be considered apart from decoration and furnishings. He hoped that the dark shades so common in dining rooms of the past—dark furniture and walls and even dark ceilings—would become completely obsolete. He even deprecated the prejudice against light carpets, which could be maintained in clean condition over quite long periods. He visualised a typical room in the future utilising approximately 2,000 watts, with a cost of less than one penny per hour.

Suggestions in regard to the lighting of bedrooms, bathrooms, hall, etc., were also made, and Mr. Owen emphasised the desirability of the practice of illuminating the numbers of houses, which before the black-out was becoming more usual, and in some countries had been made compulsory.

Other possibilities included the

floodlighting of small houses and gardens; for example, on housing estates, where the removal of obstructing high fences and privet hedges had been recommended.

REFLECTIONS. by W. BROWNING, Wh.Ex., M.I.E.E. (*Member*).

Summary of a paper read before the Manchester Centre on February 10, 1944.

By descriptions of experience and by the aid of lantern slides the author sought to demonstrate that sight is based upon reflections of light from surfaces and on the available contrast, but that the process of *seeing* is not completed until the mind is satisfied that what is apparently seen is actuality. Where any doubt on this point exists, nervous strain, exemplified by some degree of distress or fatigue, arises. As illustrations Mr. Browning mentioned the troublesome effect of lighting units, seen against walls of low brightness, which had to be raised higher above the assembly benches where operators were working; the direct reflections of tubular fluorescent lamps in the concave keys of typewriters; the painting of the bodies of bench drilling machines in light colour in order to reduce the brightness ratio. The whole conception of "quality" of lighting was based on *comfort*. This resulted in agility of work and action, which in turn was reflected in improved output. Mr. Browning quoted the familiar D.S.I.R. research on type-setting by hand as an instance where visual acuity was a predominant factor in continuous operation; whereas, in the case of fine engineering and machining, responsibility imposed care and caution, leading to diminished output under bad conditions. From experience in an engineering shop using 24-hour artificial lighting, he quoted the following figures. In a room devoted to *fine heavy fitting*, where the illumination was increased from 6 to 18 per cent., the expected acuity increase was 9 per cent., but the actual production increase 21 per cent. Increases in illumination of the same order in *fine heavy machining* led to an actual production of increase of 15.7 per cent. (expected acuity increase, 12.5 per cent.), and in *electric welding* to a production increase of 4.9 per cent.

THE EYE IN RELATION TO VISION.

Summary of a lecture delivered to the Huddersfield Group on February 11, 1944.

In a lecture on this subject Dr. Tomlin described the wonderful mechanism of the human eye, pointing out the analogy to a camera and discussing the effect of light thereon. He illustrated this by many practical examples, emphasising the importance of limiting glare and avoiding excessive contrast, and answered numerous questions put by the audience.

LIGHTING IN RELATION TO VISION, by S. D. LAY (*Fellow*).

Summary of an address to the Huddersfield Group on March 10, 1944.

The lecturer pointed out that increase of illumination did not in itself ensure more efficient lighting; in fact avoidance of glare and shadow and the diffusion of light were the more important factors. Mr. Lay recalled an interesting experiment carried out in a factory where the girls originally wore dark green overalls, which created a dark background to other girls working a short distance away. The green overalls were replaced by cream overalls, giving less contrast in the background, which greatly relieved eye strain. Several lantern slides were shown to illustrate the lecturer's remarks.

Additions to List of Members.

The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

SUSTAINING MEMBERS:—

Dennison Watch Case Co., Ltd. .....Villa Road, Handsworth, BIRMINGHAM, 19.
Representative: Andrew L. Dennison.

Joseph Lucas, Ltd....Great King Street, BIRMINGHAM.
Representative: F. W. Skidmore.

CORPORATE MEMBERS:—

Barron, J. D. .....1, Love Lane, Pinner, MIDDLESEX.
Bedwell, C. H. .....49, Manor Road, Barnet, HERTS.
Crossley, E. .....65, Harbour Road, Wibsey, BRADFORD.
Cutmore, R. R. .....31, Belmont Avenue, New Malden, SURREY.
Davoile, J. H. M. .....Lee, Beesley and Co., Ltd., 53, Southgate St., GLOUCESTER.
Ellerker, W. H. .....“Clent,” Wooler Road, WEST HARTLEPOOL.
Ellis, A. .....46, Harts Green Road, Harborne, BIRMINGHAM, 17.
Ellis, F. A. .....Corporation Electricity Dept., Market St., HUDDERSFIELD.
Francis, A. J. .....14, Wensley Bank, Thornton, BRADFORD.
Gardner, B. .....49, Blythsford Road, Hall Green, BIRMINGHAM, 28.
Granger, L. J. .....The Crescent, 352, Green Lane Road, LEICESTER.
Harper, T. W. .....108, Birchington Avenue, South Shields, DURHAM.
Harrison, F. .....21, Amberley Road, Sale, CHESHIRE.
Haselhurst, A. .....12, Alton Drive, BRADFORD.
Jacobi, E. .....15, Leeside Crescent, LONDON, N.W.11.
James, I. .....The General Electric Co., Ltd., Witton, BIRMINGHAM, 6.
Johnstone, T. R. .....93, Hope Street, GLASGOW, C.2.
Lawson, D. .....c/o White, 9, Holytown Road, Bellshill, LANARKSHIRE.
Miller, W. H. .....21, Knoll Road, Wandsworth, LONDON, S.W.18.
Moore, R. E. .....224, Rookery Road, Handsworth, BIRMINGHAM, 21.
Pethed, C. J. .....“Kitley,” Pontefract Road, Purston, YORKSHIRE.
Preston, J. E. .....68, Huddersfield Road, Meltham, Nr. HUDDERSFIELD.
Rainero, U. C. W. ...73, Astley Road, Handsworth, BIRMINGHAM, 21.
Ross, C. K. .....59, Allan Park Drive, EDINBURGH, 11.
Scott, C. J. W. .....42, Longland Drive, Totteridge Lane, LONDON, N.20.
Sharp, L. C. .....Rowbarns Grange, East Horsley, SURREY.
Strutt, C. .....20, St. Chads View, LEEDS, 6.
Tew, A. .....4, Hurst Lodge, Stanley Avenue, Alperton, MIDDLESEX.
Thompson, R. J. .....72, Carlisle Street, Winson Green, BIRMINGHAM, 18.
Vowler, J. C. G. .....4, Collingham Road, LONDON, S.W.5.

ASSOCIATE:—

Makepeace, S. H.....21, Rutland Street, LEICESTER.

LIST OF I.E.S. REGIONAL COMMITTEES—*(continued from page 62)*

GROUPS:

BRADFORD GROUP (NORTH MIDLAND AREA).
Chairman: W. H. Naylor. *Hon. Secretary:* A. J. Hutchison. *Committee:* W. Ineson, J. Longthorne, H. Moss, G. Mountain, J. H. Rogerson, H. A. Shackleton, A. Southern, F. S. Warburton.

DERBY GROUP (MIDLAND AREA).
Chairman: F. H. Pooles. *Hon. Secretary:* C. S. Wheeler. *Committee:* C. H. Aslin, W. H. Buxton, L. A. Doxey, V. A. Gilman, M. R. H. Sadler, E. Jewitt.

HUDDERSFIELD GROUP (NORTH MIDLAND AREA).
Chairman: Dr. J. Whitaker. *Hon. Secretary:* E. Wood. *Committee:* R. Hardy, E. Lunn, H. P. Ripley, W. Robinson, H. Singleton, J. T. Thornton, W. Turner, H. L. Walker.

LEICESTER GROUP (MIDLAND AREA).
Chairman: D. G. Woolfenden. *Vice-Chairman:* J. Martin. *Hon. Secretary:* G. Bingham. *Committee:* E. H. Billing, S. C. Ginno, W. I. Hodgkins, H. H. S. Mansfield, F. A. Smith, T. Wilkie, F. S. Yates.

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LIST OF I.E.S. REGIONAL COMMITTEES

AREAS:

MIDLAND AREA.

Chairman: W. J. G. Davey. *Secretary:* C. J. Allderidge. *Committee:* C. S. Caunt, A. Hacking, J. Martin, F. H. Pooles, A. J. Pashler, W. J. P. Watson.

NORTH MIDLAND AREA.

Chairman: W. G. Thompson. *Secretary:* R. Pye. *Asst. Secretary:* J. A. Whittaker. *Committee:* J. T. Grimshaw, A. Kelso, J. W. Howell, J. H. Mollan, E. G. R. Taylor.

(In other Areas the only existing Centre Committee serves as the Area Committee.)

CENTRES:

BATH AND BRISTOL CENTRE (WESTERN AREA).

Chairman: J. B. Harris. *Vice-Chairman:* E. J. Ireland. *Joint Secretaries:* R. E. Tucker, and D. J. Sawkins. *Hon. Treasurer:* S. M. Richman. *Committee:* R. S. Hazell, W. A. Laughton, Miss E. L. Lee, Mrs. M. B. Probst, L. C. Rettig, W. Rush.

BIRMINGHAM CENTRE (MIDLAND AREA).

Chairman: A. J. Pashler. *Vice-Chairman:* J. G. Holmes. *Hon. Secretary:* C. J. Allderidge. *Hon. Treasurer:* F. F. Middleton. *Committee:* F. L. Cator, P. Hartill, J. G. Holmes, R. Hulse, H. A. Keeling, R. Mackenzie, C. F. Partridge, W. E. Prendergast, T. H. Yarcoe.

CARDIFF CENTRE (SOUTH WALES AREA).

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